

CLAIMS

1. An insulating ceramic composition comprising:

a first ceramic powder including forsterite as a main component;

a second ceramic powder including at least one ceramic powder selected from the group consisting of a calcium titanate-based ceramic powder mainly containing calcium titanate, a strontium titanate-based ceramic powder mainly containing strontium titanate, and a titanium oxide-based ceramic powder mainly containing titanium oxide; and

borosilicate glass powder,

wherein the borosilicate glass contains 3 to 15 percent by weight of lithium in terms of  $\text{Li}_2\text{O}$ , 30 to 50 percent by weight of magnesium in terms of  $\text{MgO}$ , 15 to 30 percent by weight of boron in terms of  $\text{B}_2\text{O}_3$ , 10 to 35 percent by weight of silicon in terms of  $\text{SiO}_2$ , 6 to 20 percent by weight of zinc in terms of  $\text{ZnO}$ , and 0 to 15 percent by weight of aluminum in terms of  $\text{Al}_2\text{O}_3$ .

2. The insulating ceramic composition according to Claim 1, wherein the borosilicate glass powder content is 3 to 20 percent by weight.

3. The insulating ceramic composition according to Claim 1, wherein the first ceramic powder content is 70 percent by weight or more, and the second ceramic powder content is 6

to 30 percent by weight.

4. The insulating ceramic composition according to Claim 1, further comprising a third ceramic powder including at least one ceramic powder selected from the group consisting of a copper oxide-based ceramic powder mainly containing copper oxide ( $\text{CuO}$ ), an iron oxide-based ceramic powder mainly containing iron oxide ( $\text{Fe}_2\text{O}_3$ ), and a manganese oxide-based ceramic powder mainly containing manganese oxide ( $\text{MnO}_2$ ),

wherein the third ceramic powder has a copper oxide-based ceramic powder content of 0.5 parts by weight or less, an iron oxide-based ceramic powder content of 1 part by weight or less, and a manganese oxide-based ceramic powder content of 2 parts by weight or less, relative to 100 parts by weight in total of the first ceramic powder, the second ceramic powder, and the borosilicate glass powder while the total third ceramic powder content is 2.5 parts by weight or less.

5. The insulating ceramic composition according to Claim 1, wherein the borosilicate glass has a composition from which a  $\text{Li}_2(\text{Mg}, \text{Zn})\text{SiO}_4$  crystal phase can be separated.

6. The insulating ceramic composition according to Claim 1, wherein the forsterite has a  $\text{MgO}/\text{SiO}_2$  molar ratio in the range of 1.92 to 2.04.

7. The insulating ceramic composition according to Claim

6, wherein the first ceramic powder contains 5 percent by weight or less of impurities apart from the forsterite.

8. The insulating ceramic composition according to Claim 1, wherein the first ceramic powder has a center particle size D50 of 1  $\mu\text{m}$  or less.

9. The insulating ceramic composition according to Claim 1, wherein the second ceramic powder contains the strontium titanate-based ceramic powder and the titanium oxide-based ceramic powder.

10. The insulating ceramic composition according to Claim 9, wherein the strontium titanate-based ceramic powder content is 6 to 13 percent by weight and the titanium oxide-based ceramic powder content is 0.5 to 5.5 percent by weight.

11. The insulating ceramic composition according to Claim 1, wherein the second ceramic powder contains the strontium titanate-based ceramic powder, and the strontium titanate has a  $\text{SrO}/\text{TiO}_2$  molar ratio in the range of 0.92 to 1.05.

12. The insulating ceramic composition according to Claim 11, wherein the strontium titanate-based ceramic powder contains 1 percent by weight or less of impurities apart from the strontium titanate.

13. The insulating ceramic composition according to Claim 11, wherein the strontium titanate-based ceramic powder has a specific surface area of 1.5 to 7.5  $\text{m}^2/\text{g}$ .

14. The insulating ceramic composition according to Claim

11, wherein the strontium titanate-based ceramic powder exhibits an X-ray diffraction pattern having a peak of the  $\text{SrTiO}_3$  (222) plane with an integrated intensity of 1000 or more.

15. A insulating ceramic sintered compact prepared by firing the insulating ceramic composition as set forth in any one of claims 1 to 14 at a temperature of  $1000^\circ\text{C}$  or less.

16. A monolithic ceramic electronic component comprising: a plurality of stacked insulating ceramic layers, the insulating ceramic layers, each comprising the insulating ceramic sintered compact as set forth in Claim 15; and wiring conductors mainly containing copper or silver, the wiring conductor being formed in association with the insulating ceramic layers.

17. The monolithic ceramic electronic component according to Claim 16, further comprising highly dielectric ceramic layers stacked together with the insulating ceramic layers, the highly dielectric ceramic layers having a relative dielectric constant of 15 or more.

18. The monolithic ceramic electronic component according to Claim 16, wherein the highly dielectric ceramic layers comprise a highly dielectric material containing:

a main constituent expressed by  $x(\text{Ba}_a\text{Ca}_b\text{Sr}_c)\text{O}-y\{(\text{TiO}_2)_{1-m}(\text{ZrO}_2)_m\}-z\text{Re}_2\text{O}_3$  (wherein  $x$ ,  $y$ , and  $z$  are in mol% and satisfy  $x+y+z = 100$ ;  $a+b+c = 1$ ,  $0 \leq b+c < 0.8$ , and  $0 \leq m < 0.15$

hold; and Re represents at least one of rare earth elements), containing  $(\text{Ba}_a\text{Ca}_b\text{Sr}_c)\text{O}$ ,  $\{(\text{TiO}_2)_{1-m}(\text{ZrO}_2)_m\}$ , and  $\text{Re}_2\text{O}_3$  in a molar ratio  $(x, y, z)$  lying in an area surrounded by lines connecting points A(7, 85, 8), B(7, 59, 34), C(0, 59, 41), and D(0, 85, 15) in the ternary diagram shown in Fig. 3 attached (not lying on the line connecting points A and B);

a first accessory constituent including  $\text{SiO}_2$ -based glass; and

a second accessory constituent containing Mn,

wherein the highly dielectric material contains 0.1 to 25 parts by weight of the first accessory constituent and 0.5 to 20 parts by weight of the second accessory constituent in terms of Mn, relative to 100 parts by weight of the main constituent.

19. The monolithic ceramic electronic component according to Claim 18, wherein the highly dielectric material further contains  $\text{Li}_2\text{O}$ .

20. The monolithic ceramic electronic component according to Claim 16, wherein the highly dielectric ceramic layers comprise a highly dielectric material containing:

a  $\text{BaO-TiO}_2\text{-ReO}_{3/2}$ -based ceramic composition expressed by  $x\text{BaO-yTiO}_2\text{-zReO}_{3/2}$  (wherein  $x, y$ , and  $z$  are in mol% and satisfy  $x+y+z = 100$ ;  $8 \leq x \leq 18$ ,  $52.5 \leq y \leq 65$ , and  $20 \leq z \leq 40$  hold; and Re represents at least one of rare earth elements); and

a glass composition containing 10 to 25 percent by weight of  $\text{SiO}_2$ , 10 to 40 percent by weight of  $\text{B}_2\text{O}_3$ , 25 to 55 percent by weight of  $\text{MgO}$ , 0 to 20 percent by weight of  $\text{ZnO}$ , 0 to 15 percent by weight of  $\text{Al}_2\text{O}_3$ , 0.5 to 10 percent by weight of  $\text{Li}_2\text{O}$ , and 0 to 10 percent by weight of  $\text{RO}$  (wherein R represents at least one selected from among Ba, Sr, and Ca).